EFFECTS OF INCREASING COW URINE DEPOSITION AREA ON SOIL MINERAL NITROGEN MOVEMENT AND PASTURE GROWTH ON A RECENT SOIL IN THE MANAWATU REGION, NEW ZEALAND

A thesis presented in partial fulfilment of the requirements for the degree of

Master of

Environmental Management

at Massey University, Manawatū, Palmerston North,

New Zealand

MASSEY UNIVERSITY

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2017

To my parents, Juan Carlos and Melania,
who without expecting anything in return
gave me the best of them.

Abstract

The cow urine patch is a major source of nitrate (NO_3^-) leaching from grazed dairy pasture farms. Increasing the urine deposition area is a direct way of reducing the potential risk of this cause N leaching losses. Research is required to quantity the effectiveness of this mitigation across a range of different soil and climatic conditions. The objective of this study was to determine the effect of increasing the cow urine deposition area on NO_3^- leaching risk and short-term pasture accumulation on Recent soil in the Manawatu Region, New Zealand. A field trial was conducted, which consisted of three treatments evaluated on pasture plots: Urine (1 m^2), Urine (0.2 m^2) and No-urine. The two urine treatments received the same volume of 2.1 L urine/patch. Urine treatments were applied on the 6th of March 2017, and soil inorganic N was measured on three occasions; 15, 36 and 53 days after urine application (DAUA). At the third soil sampling time, which was 24 days after the drainage season was estimated to have commenced, the net inorganic N (inorganic N in the urine treatment minus the value for the No-urine treatment) in the 45-120 cm soil depth was 1.08 g net inorganic N/patch for the Urine (1 m^2) treatment compared to 2.97 g net inorganic N/patch for the Urine (0.2 m2) treatment. Therefore, the Urine (1 m^2) treatment resulted in a 63.6% reduction in the quantity of net inorganic N that was highly susceptible to leaching, compared to the more typical urine patch area of 0.2 m^2. At a paddock scale, when net inorganic N from the urine treatments is multiplied by an estimate of the quantity of urine patches per hectare in a single grazing, this equates to a reduction of 2.53 kg N/ha from a single autumn grazing. It is expected that increasing urine deposition area at multiple grazings would result in greater reductions in the annual NO_3^- leaching risk.

Over the two pasture harvests conducted in the trial, the pasture DM accumulation for the No-urine treatment produced an average of 3220 kg DM/ha. The two urine patch treatments achieved a similar level of pasture DM accumulation to that of the No-urine treatment. The lack of a pasture growth response from the added urine could have been influenced by the high clover content (35.9%) of the pasture, and in addition, there may have been adequate background soil mineral N levels, which together could have contributed to N not being growth limiting during the trial.

This research has demonstrated that increasing cow urine deposition area in autumn has potential to be an effective mitigation for decreasing N leaching losses from grazed dairy pastures. Further research is required to investigate the effects of increasing cow urine deposition area at multiple grazings, in order to determine the effect of this mitigation option on annual NO_3^- leaching and pasture production.

Acknowledgements

This study would not have been possible without the support of the Soil & Earth Sciences Group, Institute of Agriculture & Environment, Massey University, which provided me with the necessary research facilities.

I am especially grateful to my supervisor, Dr James Hanly, who gave me the opportunity to work in the nutrient management field; and who actively guided and supported me throughout this thesis. Most of all thank you for helping me with the field and lab work, as well as for the patience correcting my English writing, I would not have been able to do it alone.

I would also like to acknowledge Dr Peter Bishop, for the practical knowledge that assisted me in the field and lab work, as well as for the provision of information to process my experimental data; Dr Dave Horne for providing important data for the interpretation of my results; and the laboratory technicians, especially Ian Furkert who patiently guided me during the analysis of my samples.

The accomplishment of this Master degree would not have been possible without the support of the New Zealand Aid Scholarship Programme. Thank you for giving me the possibility to study outside my country and for helping me in the search for solutions to improve the environmental situation in Paraguay.

Special thanks to the International Student Support Office of Massey University, particularly to Jaime Hooper, who helped me since I was granted with the scholarship. And to the Environmental Management Master staff, especially John Holland and Karen Hytten; as well as my officemates.

To my flatmates, Aniek, Sandeep and Ermanno, to my dear Paraguayan friend Puchi Pu, and to my Palmy family, it would have been really hard without your support.

Finally, I would like to express sincere gratitude to my family, nobody has been more supportive in the pursuit of this dream than you. My parents Juan Carlos and Melania, thanks for your love and guidance that were with me even being on the other side of the world, and to my siblings, Magali and Juan Esteban, who always supported me in their own ways and that secretly were missing me a lot.

I thank God for giving me the opportunity to achieve another goal and for not letting me give up on hard times. This chapter of my life is over, but I am sure you have prepared for me new challenges, lessons, and friends, just like everything you gave me in this journey.

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